



# Proposed Revisions to 314 CMR 4.00: Massachusetts Surface Water Quality Standards Regulation

## Copper Freshwater Criteria Update

### MassDEP Proposes to Retain the Freshwater Copper Hardness-Dependent Criteria and Adopt EPA's 2007 Copper Freshwater Criteria

#### Background and Reason for Change

The purpose of the 314 CMR 4.00: *Massachusetts Surface Water Quality Standards* (SWQS) regulation is to restore, enhance, and protect the chemical, physical, and biological integrity of surface waters in Massachusetts. The SWQS were adopted to designate the most sensitive uses for which surface waters are to be regulated, prescribe the minimum water quality criteria required to sustain those uses, restore waters to those uses, and maintain high quality waters.

The Federal Water Pollution Control Act, 33 USC §1251, et seq. (known as the Clean Water Act or CWA) and associated federal Water Quality Standards, 40 CFR Part 131, require the U.S. Environmental Protection Agency (EPA) to periodically publish updated or new recommended ambient water quality criteria (AWQC). The CWA and these federal regulations also require states to periodically review and, as appropriate, to update the AWQC they have adopted in State regulations. Each State has the option of either adopting the federally recommended criteria or developing its own criteria, subject to EPA review and approval. EPA may also promulgate criteria for a State that develops criteria that are not protective or that neither adopts EPA's recommended criteria nor develops its own.

Copper is a trace metal found in the earth's crust. It is naturally present in surface water due to soil weathering that typically produces low ambient copper concentrations. Human activities, such as wastewater effluent discharges, can also release copper into aquatic systems. Copper is essential for aquatic life, but at elevated concentrations it can impair biological processes and lead to death. Aquatic life pollutant criteria are derived to protect aquatic organisms from lethal effects (acute criteria) as well as effects on growth and reproduction (chronic criteria). Water chemistry parameters such as pH and dissolved organic carbon (DOC) can affect copper availability and toxicity. Currently, the SWQS copper criteria reflect EPA's 1996 guidance that are based on hardness-dependent equations (see Table 1).

#### EPA Guidance

In a 2007 guidance document, EPA updated its recommended copper criteria. Under this guidance, copper criteria are derived using the Biotic Ligand Model (BLM, version 2.2.3). The BLM generates criteria that incorporate the effects of water chemistry on the bioavailability and toxicity of copper, requiring ten water chemistry parameters as inputs (see Table 2). The BLM provides a framework to develop protective criteria for organisms within a range of conditions.

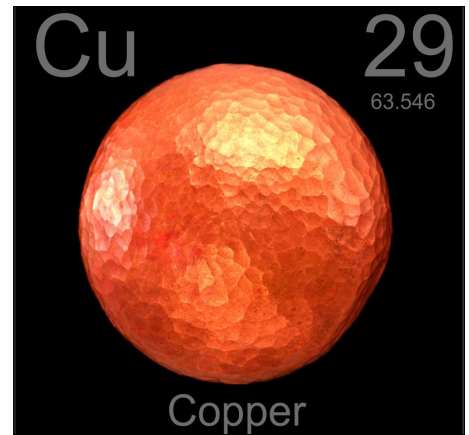


Photo: <https://periodictable.com>

#### Spotlight

The Biotic Ligand Model (BLM) generates criteria that incorporate the effects of water chemistry on the bioavailability and toxicity of copper, requiring ten water chemistry parameters as inputs. The BLM provides a framework to develop protective criteria for organisms within a range of conditions.



**Slimy sculpin**  
*Cottus cognatus*

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## Copper Freshwater Criteria Update (cont.)

### Proposed Revisions

MassDEP is proposing to adopt the copper BLM into the SWQS regulation by creating Table 29, Generally Applicable Criteria. Table 29a, the Aquatic Life Criteria table, retains the existing, and already approved, hardness-dependent equations as the default method to calculate copper criteria. Table 29a also incorporates the BLM as another option to calculate copper criteria. To use the BLM, ten water quality input parameters (see Table 2 below) would need to be collected. If the proposed revisions are approved by EPA, and data are available to calculate both hardness-dependent and BLM criteria for a given location, the BLM criteria would supersede the hardness-dependent criteria. Copper criteria are expressed as dissolved concentrations and vary by location, while remaining protective of aquatic life.

**Table 1. Parameters for Hardness-Dependent Equations to Derive Copper Criteria\***

Chemical	$m_A$	$b_A$	$m_C$	$b_C$	Freshwater Conversion Factors (CF)	
					CMC (Acute)	CCC (Chronic)
Copper	0.9422	-1.7	0.8545	-1.702	0.96	0.96

\*Copper criteria for various ambient hardness concentrations shall be calculated using the following equations:

For CMC (Criterion Maximum Concentration; Acute):  $CMC (dissolved) = \exp\{m_A [\ln (hardness)] + b_A\} (CF)$

For CCC (Criterion Continuous Concentration; Chronic):  $CCC (dissolved) = \exp\{m_C [\ln (hardness)] + b_C\} (CF)$

If the ambient hardness concentration exceeds 400 mg/L, either:

- (1) a default hardness of 400 mg/L shall be used in the above equations, or
- (2) the BLM, with a set of ten input parameters, may be used in place of the above equations.

**Table 2. Ten Input Parameters for the Biotic Ligand Model (BLM) to Derive Copper Criteria**

Alkalinity	pH
Calcium	Potassium
Chloride	Sodium
Dissolved Organic Carbon	Sulfate
Magnesium	Temperature

### Regulatory Implications

For facilities permitted under the National Pollutant Discharge Elimination System and MassDEP's Surface Water Discharge Program, water quality criteria cannot be used for establishing effluent limits until they have been promulgated into the SWQS and approved by EPA. The implications of the proposed copper criteria revisions will vary by facility, dependent on the water chemistry of specific discharge locations and whether copper criteria are derived using either the hardness-dependent equations or BLM. Facilities interested in data collection for the BLM would need to consult MassDEP early in the process to develop a Quality Assurance Project Plan. MassDEP plans to release a guidance document for facilities on data requirements and implementation procedures for copper criteria when the proposed SWQS revisions are finalized. Please also refer to the Antidegradation and Anti-Backsliding Implementation fact sheet for more permit implications.

For more information about EPA's copper criteria and the copper BLM see EPA guidance at <https://www.epa.gov/wqc/aquatic-life-criteria-copper>

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